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ABSTRACT

The new research and practice area of "adults and mathematics" is situated within the didactics of mathematics as it is structured and delimited by the concrete forms of practice and knowledge currently regarded as mathematics teaching, learning, and knowing. "Adults Learning Mathematics" (ALM) is a community of practice and research within the didactics of mathematics in which adults' learning and numeracy are central and where the reason to teach mathematics is empowerment for social and working life. Epistemological reconnaissances have resulted in these five conclusions on ALM: (1) The ALM community of practice and research is accepted as a domain within the didactics of mathematics; (2) the learner is the focus of the ALM studies, and her/his "numeracy" is understood as mathematics knowledge; (3) didactic questions are integrated with general adult education questions in ALM and the studies are interdisciplinary; (4) the duality between the objective and subjective perspective is implicit, or explicit, in all ALM problematics; and (5) the general aim of ALM practice and research is "empowerment" of adults learning math. Interdisciplinary studies involving mathematics, sociology, and pedagogy are necessary to bridge mathematics and adult education. (Contains 3 figures and 11 references.) (MO)

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Epistemological Questions About Research and Practice in ALM

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Abstract

The subject area of the didactics of mathematics is "always-already" structured and delimited by the concrete forms of practice and knowledge that are currently regarded as mathematics teaching, learning, and knowing. The new research and practice area "adults and mathematics" is situated in the borderland between mathematics and adult education. At the fourth and fifth ALM conferences there was a debate about the characteristic features of the research area. Questions were formulated about "Adults Learning Mathematics" as a community of practice and research within the didactics of mathematics, a community where adults' learning and numeracy are placed at the centre and where the answer to the so-called justification problem (Why teach mathematics?) is empowerment for social and working life. Epistemological reconnaissances have given rise to the author's construction of the concept problematique for didactic activity in this field (adults and mathematics) where interdisciplinary studies (mathematics, sociology, pedagogy) are necessary to bridge mathematics and adult education. Reconstruction of "math-containing qualification" as a didactic concept is given as an example of interdisciplinarity.

The object of study in mathematics education research encompasses all phenomena and processes involved in, and around, the actual or potential teaching and learning of mathematics. The researchers', teachers' and learners' conceptions and definitions of mathematics are important. Thus, the subject area of this research field, also named the didactics of mathematics, is "always-already" structured and delimited by the concrete forms of practice and knowledge that are currently regarded as mathematics teaching, learning, and knowing.

By the *didactics of mathematics* I mean the scientific discipline related to research and development work in mathematics education. According to Mogens Niss there seems to be a preference in Europe for using the label "the didactics of mathematics," inspired by names such as "Didaktik der Mathematik" (German), "didactique des mathématiques" (French), "didáctica de la matemáticas" (Spanish), "matematikdidaktik" (Scandinavian languages), in spite of the slightly oblique connotations attached to the term "didactical" in English (Niss, 1999, pp. 1-2).

Three Interrelated Subject Areas

I describe the research subjects of the didactics of mathematics as stretching between three superordinate subject areas: teaching, learning, and knowing mathematics. The specific subject fields are structured and construed within or across these subjects (Wedege, 1997). On the basis of Niss' analytical description of the domain (Niss, 1999) and my own research (Wedege, 2000), I give the following short description of the three subject fields:

(1) Mathematics and math-containing teaching

Problem complexes, which can also be interdisciplinary, begin with: why, what, how, who, and where?
The focus is on communicating mathematics.
By *math-containing instruction* I mean organised communication of a single or interdisciplinary subject area where mathematics is an integrated but identifiable part. The instruction can be informal (for example, learning from one's colleagues at a place of work) or be part of a course or a study program.

(2) Learning mathematics

The problem complexes begin with: who, what, how and where?
The focus is on the learner.

(3) Mathematics knowledge, math-containing knowledge, and attitudes to mathematics

The problem complexes start with: what, where and who?

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The focus is variously on human knowledge or mathematics, the context or the situation (teaching, working life, social life, culture, etc.).

The two subject areas, (2) learning mathematics and (3) mathematics knowledge, may only be separated analytically by distinguishing between process and product. The subjects complement each other in the sense that the one does not exist without the other.

If mathematics knowledge is not only academic mathematics and school mathematics but also ethnomathematics and numeracy then mathematics teaching and learning encompasses a lot of informal activities outside schools and educational institutions. We shall look at two constructions broadening the conception of mathematics and thus the research domain.

Two Constructions in the Subject Field

The construction and delimitation of mathematics is always, explicit or implicit, on the agenda in the didactics of mathematics. In order to illustrate that, I have chosen the two concepts "ethnomathematics" and "numeracy" which both have expanded the subject area and the problem field in mathematics education and visualised the need for interdisciplinary studies.

Ethnomathematics

Mathematics has traditionally been considered a culturally independent phenomenon, but from the end of the 1970s mathematical didacticians have been aware of the societal and cultural aspects of mathematics and mathematics teaching. Ubiratan D'Ambrosio presented his ethnomathematical programme at the fourth international congress of mathematics education (ICME4) where he contrasted *academic mathematics* (the mathematics taught and learned in schools) with *ethnomathematics*, which he describes as the mathematics practised in cultural groups and sub-groups (D'Ambrosio, 1985). The point of departure for the ethnomathematical project is studies that have shown that teaching which conflicts with the hidden mathematical competencies of the participants, e.g., in their craft skills, can result in severe obstacles to learning. Ethnomathematics adopts a cultural-anthropological viewpoint thus expanding the problem field of mathematics education. (See also Gelsa Knijnik in this volume.) A problematique is constituted by means of the common value base in the research community of ethnomathematics.

Paulus Gerdes has analysed ethnomathematics as a research domain, as a subject area, and as a field of practice. He argues that it makes sense to speak of an "ethnomathematical movement" characterised for example as follows (Gerdes, 1996, pp. 917-918):

- Ethnomathematicians adopt a broad concept of mathematics, including counting, locating, measuring, designing, playing, and explaining.
- Ethnomathematicians emphasise and analyse the influences of socio-cultural factors on the teaching, learning, and development of mathematics.
- Ethnomathematicians argue that the techniques and truths of mathematics are a *cultural product* and stress that all people—every culture and subculture—develop their own particular forms of mathematics.
- Ethnomathematicians look for *cultural elements and activities* that may serve as a starting point for doing and elaborating mathematics in the classroom.
- Ethnomathematicians generally favour a socio-critical view and interpretation of mathematics education which enables students to reflect on the realities in which they live, and empowers them to develop and use mathematics in an emancipatory way.

The ethnomathematical approach is based on a thesis concerning the relationship between everyday knowledge and school knowledge, a thesis that also lies behind my interest in the everyday math-containing competencies of unskilled workers.

Numeracy

In the field of research, "adults learning mathematics," the construction and further development of a concept of "numeracy" is a task that many researchers relate to. Adult numeracy is an everyday competence bridging mathematics and everyday life. The term "numeracy" was introduced for the first time in the United Kingdom in the late 1950s as a parallel to the concept of "literacy." The need was felt for a concept for necessary, basic arithmetical proficiency corresponding to the concept for reading and writing skills.

In the last twenty years, there has been lively debate between educational planners and researchers in the English-speaking countries (the United Kingdom, the United States, Australia, etc.) about the content and meaning of the concept of "numeracy." The discussion has, inter alia, concerned questions such as: How broad is the competence? How deep? How general? How specific? Is it also a matter of democratic competence? (See, for example, FitzSimons, 1997; FitzSimons & Godden, 2000.)

The new research and practice area "adults and mathematics" is situated in the borderland between mathematics and adult education. At the fourth and fifth ALM conferences we had a debate about the characteristic features of the research area. Questions were formulated about "Adults Learning Mathematics" as a community of practice and research within the didactics of mathematics, a community where adults' learning and numeracy are placed at the centre and where the answer to the so-called justification problem (Why teach mathematics?) is empowerment for social and working life (Wedege, 1997; Wedege, Benn, & Maasz, 1998).

Two General Research Questions

My own research concerns adults' empowerment for working life including the capacity to understand and modify technology. The preliminary *didactic* question defining my problem field was:

- How could mathematics education contribute to adults' (further) developing technological competencies at the workplace? (1993-95)

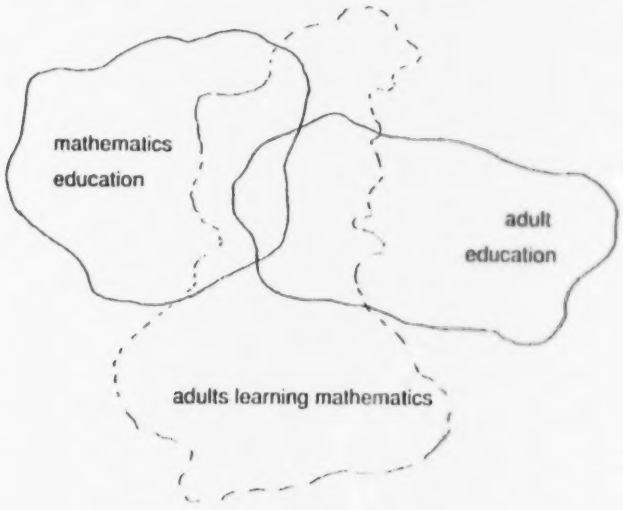
"But are you sure that mathematics is the answer to your question?" asked the German educational researcher Peter Alheit. Thus, the didactic question was reformulated and an *epistemological* question was added: What characterises a scholarly *problematique* which makes possible studies of the question:

- Is it possible that mathematics education contributes to adults' (further) developing technological competencies at the workplace? (1995-present)

In 1999, I finished and defended my doctoral dissertation with the following title: "Mathematics knowledge and technological competencies in adults with brief schooling—Reconnaissances and constructions in the borderland between the didactics of mathematics and adult education research" (Wedege, 2000). Adults Learning Mathematics is situated in the borderland between mathematics education and adult education. (See Figure 1.)

Roseanne Benn has illustrated research in adults learning mathematics in relation to the neighbouring disciplines (maths, adult education, maths education, sociology, psychology, etc.) by concentric rings (Benn in Wedege et al., 1998). "But are the 'neighbours' correctly positioned and is the picture complete?" asks Diana Coben (Coben, 1999, p. 49). Research in both adult education and mathematics education is multidisciplinary or interdisciplinary—drawing on psychology, sociology, philosophy, anthropology, etc.

Figure 1: "ALM" Situated in the Borderland Between Mathematics and Adult Education



Five Conclusions on ALM

The reconnaissances have resulted in five conclusions on the international research forum "Adults Learning Mathematics" (ALM).

(1) Preliminary place in the scientific landscape:

The ALM community of practice and research is accepted as a domain within the didactics of mathematics.

(2) Subject area:

The learner is the focus of the ALM studies, and her/his "numeracy" is understood as mathematics knowledge.

(3) Problem field:

Didactic questions are integrated with general adult education questions in ALM and the studies are interdisciplinary.

(4) Two perspectives:

The duality between the objective and subjective perspective is implicit, or explicit, in all ALM problematiques.

(5) Justification problem:

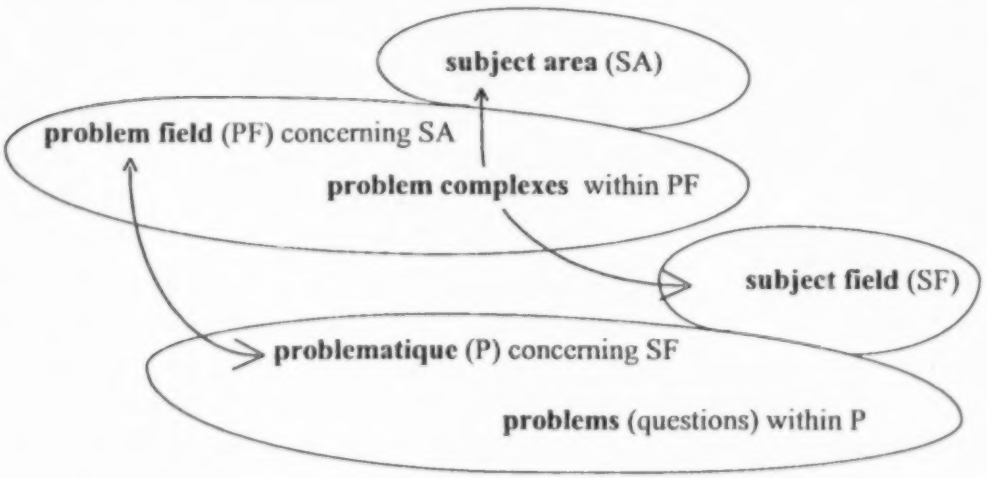
The general aim of ALM practice and research is "empowerment" of adults learning maths (Wedege in Wedege, Benn, Maasz, 1998; Wedege, 2000).

Two different lines of approach are possible and intertwined in the research: *the objective line of approach* (society's requirements with regard to adults' math-containing competencies) and *the subjective line of approach* (adults' need for math-containing competencies and their beliefs and attitudes to mathematics).

Problematique for Didactic Activity

Epistemological reconnaissances have given rise to my construction of the concept problematique for didactic activity in the field "adults and mathematics" where interdisciplinary studies (mathematics, sociology, pedagogy) are necessary to bridge mathematics and adult education. In the sections above, I have used the terms subject area, subject field, problem field, and problematique. (For a definition see Wedege, 1997.) In Figure 2, the conceptual framework is visualised.

Figure 2: An Epistemological Framework



A *problematique* in the didactics of mathematics may be characterised, inter alia, by a specific perception of mathematics, mathematics knowledge, and learning, and it can contain a value-based answer to the question: Why should society offer mathematics teaching? (the justification problem). As we have seen, ethnomathematics is an example of a new didactic problematique expanding the problem field of mathematics education.

In the didactics of mathematics, as in adult education research, multi- and interdisciplinary studies are necessary. Within the problem fields concerning ethnomathematics and numeracy, interdisciplinarity is necessary because the reasons for teaching and learning mathematics are located outside mathematics, and not within mathematics.

During the 1980s there was growing interest in practice-learning. In 1991, Lave and Wenger paved the way for a theory of learning as an integral part of social practice with the concept of learning as *legitimate peripheral participation*. However, the theory of the current community of practice as the only explanatory framework provides no possibility for understanding the inertia in adults' disposition to change their attitudes to mathematics. It is possible partly to explain how the adult learns but not why she does not learn.

Pierre Bourdieu's concept of *habitus* covers an incorporated system of tenacious dispositions as principles for readiness to act. I claim that habitus can provide a theoretical framework for the subjective conditions for adults' learning mathematics. By analysing an interview with a 75-year-old woman (Ruth) about mathematics in her life, I have illustrated and discussed by using the two analytical concepts their suitability for analysing adults' mathematics knowledge in different situation-contexts (school, work, the family, and leisure time).

On the basis of an epistemological discussion, I claimed that the concept of habitus, which was developed in a sociological problematique, could be imported into a didactic problematique about adults' learning mathematics

together with the concept of learning as legitimate peripheral participation (Wedege, 1999, 2000). Habitus is a sociological concept about people's socialisation. Another sociological and pedagogical concept to be imported and reconstructed in an ALM problematique is "qualification."

"Math-Containing Qualification" as a Didactic Concept

Reconstruction of "math-containing qualification" as a didactic concept is given as an example of inter-disciplinarity.

Figure 3: The Didactic Subject Field Compared with the Sociological and Pedagogical

Sociology	Didactics of Mathematics	Pedagogy
Socialisation Qualification (of the working power)	Mathematics knowledge Learning mathematics	Knowledge Formation/Education Qualification Learning
The societal function of teaching	Teaching mathematics and its function	Teaching

Let us take a closer look at the concept of qualification as an important link between the social and pedagogical research fields where studies in the subject area of "adult education for mathematics in the workplace" are situated. As such the concept provides a framework for didactic reflection on the relation between adult education and work (Wedege, in press b).

I define *qualifications* as the knowledge, skills, and properties that are relevant to technique and work organisation as well as to their interaction in a work function. In my definition of the concept of qualifications, I speak of *relevant* knowledge, skills, and properties rather than of *necessary* knowledge, etc. This makes it possible to perceive qualifications from two different points of view: subjective and objective, i.e., from the point of view of individual workers as well as from the point of view of the labour market. I distinguish analytically between two types of qualification:

- *specific professional qualifications*: technical-professional knowledge and skills that are directly and visibly present when the individual work function is being carried out; and
- *general qualifications*: general and professional knowledge, abilities, and competencies such as literacy and numeracy that are (often indirectly) present when a wider range of work functions are being carried out.

A third type of qualification is introduced as a quality inherent in the two others:

- *social qualifications*: personal traits/attitudes that are present in the work process such as precision, solidarity, flexibility, and ability to co-operate (Wedege, 2000).

Empirically, these types of qualifications are interwoven in the single individual. A skill or understanding might be analysed as a specific professional qualification in a work context and as a general qualification in another

context. For example, skill in reading diagrams and applying this knowledge is a specific qualification for the driver of a forklift truck, while skill in reading and understanding a chart of absence due to sickness is a general qualification for workers.

Human qualifications constitute a central element in technology where they are used, challenged, and developed at work in co-operation with and in contrast to technique and work organisation. On the basis of this conception of technology and technological development it is necessary to distinguish between necessary and relevant qualifications in analyses which are to be used for purposes of educational planning.

Conclusion

In the *International Handbook of Mathematics Education*, FitzSimons, Jungwirth, Maasz, and Schloeglmann (1996) characterised the field of adults and mathematics as having "great heterogeneity." Previously, I have argued that this is due to lack of a "grand narrative" concerning adults and mathematics and the great complexity of the subject area (Wedege et al., 1998). My preliminary reconnaissances on "Adults Learning Mathematics" as a subject area, as a research domain, and as a field of practice have led me to the conclusion that it makes sense to speak about ALM as "a community of practice and research" in spite of this heterogeneity. The reconnaissances have also given rise to construction of the terminology (subject field, problem field, problematique) which could be a means to make explicit some of the epistemological choices made by researchers and practitioners in the field (What do we mean by mathematics? What do we mean by knowledge? What do we mean by learning? etc.).

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